Remarks

Claims 1-9 are pending in the application. Claims 1-9 are rejected. All rejections and objections are respectfully traversed.

Claimed is a method that detects components of a non-stationary signal. The non-stationary signal is acquired and a non-negative matrix of the non-stationary signal is constructed. The matrix includes columns representing features of the non-stationary signal at different instances in time. The non-negative matrix is factored into characteristic profiles and temporal profiles.

Claims 1-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Large et al., U.S. Patent No. 5,751,899 (Large), in view of Jarman et al., U.S. Patent Application Publication No. 2001/0027382 (Jarman).

Large teaches a method and apparatus for the analysis of a non-stationary signal to determine the presence of pseudo-periodic components in the signal. Other than that, Large does not teach, show or suggest any of the other claimed limitations. Large does not constructing a non-negative matrix of the non-stationary signal, where the matrix includes columns representing features of the non-stationary signal at different instances in time. Nor does Large teach factorizing a non-negative matrix into characteristic profiles and temporal profiles.

The Examiner reaches for Jarman in an attempt to cure the defects of Large. Jarman provides methods for identifying a feature in an indexed dataset.

Nowhere in Jarman is there any teaching that his matrices are non-negative matrices. There is not a single mention that would indicate that Jarman's datasets are in the form of non-negative matrices. Furthermore, nowhere does Jarman indicate that his datasets are constructed form non-stationary signals. The datasets of Jarman are incompatible with the non-stationary signals of Large, and the teachings cannot be combined.

Paragraph [0004] is reproduced below.

"[0004] As used herein, the term "indexed dataset" or "spectrum" refers to a collection of measured values called responses where each response is related to one or more of its neighbor element(s). The relationship between the one or more neighbor elements may be, for example, categorical, spatial or temporal. In addition, the relationship may be explicitly stated or implicitly understood from knowing the type of response data and/or how such data were obtained. When a unique index, either one dimensional or multi-dimensional, is assigned to each response, the data are considered indexed. One dimensional indexed data is be defined as data in ordered pairs (index value, response). The index values represent values of a physical parameter such as time, distance, frequency, or category; the responses can include but are not limited to signal intensity, particle or item counts, or concentration measurements. A multi-dimensional indexed dataset or spectrum is also ordered data, but with each response indexed to a value for each dimension of a multi-dimensional array. Thus a two-dimensional matrix has a unique row and column address for each response (index $value_1$, index $value_2$, response)."

Applicant cannot find any indication where non-stationary signals, as known in the art, are described. Nor does paragraph [0004] describe non-negative matrices. This paragraph does not describe a "matrix including columns

representing features of the non-stationary signal at different instances in time."

The Examiner also makes reference to paragraph [0083]

> **[0083]** As known from multivariate normal theory, the likelihood ratio statistic Λ for testing the null hypothesis is the ratio of the determinants of the sample covariance matrix and the hypothesized covariance matrix. Thus the test is based on the ratio expressed by Equation 9:
>
> $$\Lambda = determinant(IWCV)/determinant(E[IWCV]) \quad (9)$$

This paragraph describes a covariance matrix. Those of ordinary skill of the art would not confuse a covariance matrix with a non-negative paragraph. This paragraph does not describe non-stationary signals. Nor does this paragraph describe a "matrix including columns representing features of the non-stationary signal at different instances in time."

The Examiner recites paragraph [0038] as teaching factoring a non-negative matrix into characteristic profiles and temporal profiles:
"[0038] FIGS. 12a and 12b are representations of profiles across the 7th row of the intensity matrix and the test statistic matrix, respectively." This is simply a description of figures. There is nothing in Jarman that describes non-negative matrix factorization.

A fairly simple explanation of non-negative matrix factorization is available at *Wikipedia*, which is easy to understand for those skilled in the art, partly transcribed herein for the record.

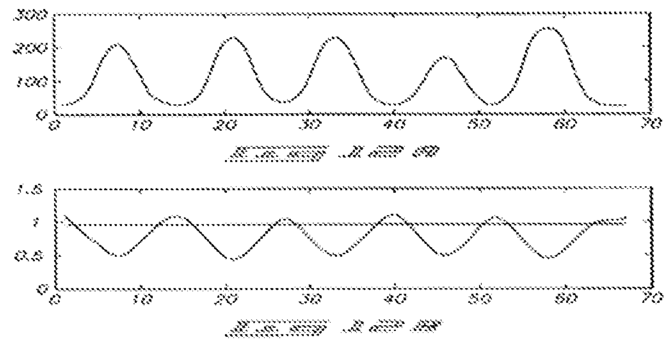
Non-negative matrix factorization (NMF) is a group of methods in multivariate analysis and linear algebra where a matrix, X, is factorized into two matrices, W and H:

$$\mathrm{nmf}(\mathbf{X}) \rightarrow \mathbf{WH}.$$

The factorization of matrices is generally non-unique, and a number of different methods of doing so are known, e.g., principal component analysis (PCA) and singular value decomposition (SVD) by incorporating different constraints.

In contrast, non-negative matrix factorization differs from those methods in that it enforces the constraint that all three matrices must be non-negative, i.e., all elements must be equal to or greater than zero, also see Specification paragraph [0030]: "As shown in Figures 4A-4B, the non-negative matrix $\mathbf{F} \in \mathrm{R}^{M\times N}$ is factored into two non-negative matrices $\mathbf{W} \in \mathrm{R}^{M\times R}$ (161) and $\mathbf{H} \in \mathrm{R}^{R\times N}$ (162), where $R \leq M$, such that an error in a non-negative matrix reconstructed from the factors is minimized."

Applicant is puzzled how the Examiner can interpret the following diagram as teaching or suggest non-negative matrix factorization as known in the art, see above.



There is nothing, even remotely, that resembles non-negative matrix factorization as claimed and as known in the art, in Jarman. In fact, Jarman does not teach matrix factorization of any kind. With all due respect, the Jarman reference is completely inappropriate and does not cure the defects of Large.

Paragraph [0008] reveals no additional information that, when combined with Large, would make the invention obvious.

Applicant claims "The method of claim 1 in which the non-negative matrix has M temporally ordered columns where M is a total number of histogram bins into which the features are accumulated, such that $M = (L/2+1)$, for a signal of length L."

As stated about Jarman does not teach matrix factorization of any kind. The Examiner references paragraph [0021] in Jarman:

> However, Jarman et al. do teach in which the non-negative matrix has M temporally ordered columns where M is a total number of histogram bins into which the features are accumulated, such that M=(L/2+1), for a signal of length L (page 2 paragraph 21; the total length is the half plus one, which is an overlapped signal or displacement from one point of origin and the response which represents an intensity at that displacement)

In fact, Jarman describes:

"[0021] In one-dimensional applications, a histogram created from the data collected from within the first widow-of-interest will essentially be a one-dimensional (1-D) discrete uniform distribution, which is understood to be a histogram where the intensity of any bin is approximately the same for all bins. On the other hand, where an actual signal or transient feature is present within a second window-of-interest, the distribution of intensities across the window will be unequal and a histogram created from the data of that second window will show at least one bin with an intensity unequal to the other bins. Thus the difference between the distribution of intensities or signals from one window-of-interest to another are advantageously employed to detect the presence of an actual signal or peak within a spectrum or indexed dataset. As mentioned above, for MALDI-MS, index values or bins are generally m/z ratios and the responses are generally the corresponding intensities. However other index values and responses can be used to form an indexed dataset or spectrum. For example, some spectra that can be evaluated by embodiments in accordance with the present invention that encompass an index value which is a physical displacement from a point of origin and a response which represents an intensity at that displacement. In addition, embodiments of the present invention can also be employed to evaluate a multi-dimensional spectrum or multi-indexed dataset. Thus, as will be discussed, some embodiments are advantageously used to detect and/or characterize transient features from datasets that incorporate a first index value, a second index value and a response."

There is nothing in the above paragraph that would indicate that Jarman has a non-negative matrix with M temporally ordered histogram bins, and that the number of bins is $(L/2+1)$, for a signal of length L. With all due respect the Applicant does not understand " which is an overlapped signal or displacement form one point of origin and the response which represents an

intensity of that displacement." Clarification of this statements is respectfully requested.

With respect to claim 4, Applicant restates that Jarman is silent on non-negative matrix factorization.

With respect to claim 5, neither Large alone or in combination with Jarman teaches constructing a non-negative matrix from acoustic signals, and factoring the non-negative matrix thus constructed.

Figures 2A and 2B show an 1D mass/charge ratio, and not a 2D visual signal, e.g., an image. photograph or video. The input signal from an acoustic transducer as described by Jarman is one-dimensional time-series data, and not "a 3D-scanned signal and frames of the signal represent volumes."

Jarman describes:
"[0044] The term "measure of dispersion" is understood herein to encompass a moment estimate which includes, but is not limited to, estimates of variance, covariance, mean squared error, skewness, kurtosis, absolute deviation, trimmed or weighted moments, and combinations thereof." There is nothing there that would indicate that the number of components of non-negative matrix R is known or estimated.

It is believed that this application is now in condition for allowance. A notice to this effect is respectfully requested. Should further questions arise concerning this application, the Examiner is invited to call Applicants'

attorney at the number listed below. Please charge any shortage in fees due in connection with the filing of this paper to Deposit Account 50-0749.

Respectfully submitted,
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